



WHAT IS CLAIMED IS:

1. A method for fabricating a semiconductor device, comprising the steps of:

depositing a fluorine-containing organic film on a semiconductor substrate using a material gas containing fluorocarbon as a main component in a reactor chamber of a plasma processing apparatus; and

densifying the fluorine-containing organic film by exposing the fluorine-containing organic film to plasma of a rare gas in the same reactor chamber.

2. The method for fabricating a semiconductor device of Claim 1, wherein the step of depositing a fluorine-containing organic film includes the step of depositing the fluorine-containing organic film while cooling the semiconductor substrate.

3. The method for fabricating a semiconductor device of Claim 1, wherein the step of densifying the fluorine-containing organic film includes the step of exposing the fluorine-containing organic film to the plasma of a rare gas in a state where the semiconductor substrate has moved toward a plasma generation region in the reactor chamber.

4. The method for fabricating a semiconductor device of Claim 1, wherein the fluorocarbon is  $C_5F_8$ ,  $C_3F_6$ , or  $C_4F_6$ .

5. The method for fabricating a semiconductor device of Claim 1, wherein the rare gas is argon gas.

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6. A method for fabricating a semiconductor device comprising the steps of:

forming a mask pattern made of a resist film or an insulating film on a metal film deposited on a semiconductor substrate;

dry-etching the metal film using the mask pattern to form a plurality of metal interconnections made of the metal film;

depositing an interlayer insulating film made of a fluorine-containing organic film between the plurality of metal interconnections and on top surfaces of the metal interconnections using a material gas containing fluorocarbon as a main component in a reactor chamber of a plasma processing apparatus; and

densifying the fluorine-containing organic film by exposing the fluorine-containing organic film to plasma of a rare gas in the same reactor chamber.

7. The method for fabricating a semiconductor device of Claim 6, wherein the step of forming a mask pattern includes the steps of:

depositing the insulating film on the metal film;

forming a resist pattern on the insulating film; and

dry-etching the insulating film using the resist pattern to form the mask pattern, and

the step of dry-etching the insulating film is performed

Sub B5

in the same reactor chamber.

8. The method for fabricating a semiconductor device of Claim 6, wherein the fluorocarbon is  $C_5F_8$ ,  $C_3F_6$ , or  $C_4F_6$ .

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9. The method for fabricating a semiconductor device of Claim 6, wherein the rare gas is argon gas.

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